Industrial Standardization

and Commercial Standards Monthly

January

1937

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This Issue: ***Front Cover: Leopold Stokowski leading the Philadelphia Orchestra. From The Big Broadcast of 1937. Courtesy Paramount Productions, Inc.***

JANUARY 1937

INDUSTRIAL STANDARDIZATION AND COMMERCIAL STANDARDS MONTHLY is published by the American Standards Association, 29 West 39th Street, New York, with the cooperation of the National Bureau of Standards

Vol. 8 No. 1

Subscription price $4.00 per year U. S. and Canada (foreign $5.00); single copies 35 cents

Standard Definitions Clarify Science of Acoustics

Definitions for acoustical terms, agreed on by science and industry through the American Standards Association, give common understanding for architectural acoustics, aids to hearing, conversion of electrical energy to sound, acoustic transmission systems, and music

Committee determines international views as basis for world-wide "sound" language

by

H. A. Frederick[1]

Chairman, Subcommittee on Terminology Sectional Committee on Acoustical Measurement and Terminology

THE last 25 years have seen the development of a new science of acoustics and its use in numerous ways which affect our everyday life. The prediction, design, control, and correction of the acoustics of rooms and auditoriums is no longer an occult art. We are becoming noise conscious and are rapidly learning how to achieve some degree of quietness. With the advent of equipment to reinforce and direct the voice, a speaker can be heard by any number of people locally and with the further development of radio broadcasting and the addition of sound to motion pictures, both distance and time have been removed as limitations.

The rapid development of this new science has required many new concepts, each of which has needed a name. Although many of these names

[1]Bell Telephone Laboratories, New York.

are old, their exact definition in many cases is new. Moreover, it is not enough that names and exact definitions be provided. There must be agreement among scientific workers that they are correct and adequately fitted to their practical needs, and this agreement should preferably be world-wide. By wide and active cooperative effort during the last few years a good start has been made in setting up and defining such a system of nomenclature.

What is meant by the "intensity of a sound?" A few years ago almost any one could have expressed an opinion but these would have varied widely. If to settle the question you went to the recognized textbooks on sound you would with difficulty find an explicit definition and you might find as many as six different concepts referred to as "sound intensity." You might find more than one in the same book. Today, by referring to the "American Standard Acoustical Terminology" a clear and concise definition will be found, together with notes describing procedures for calculating sound intensity in certain specified cases.

Science Enters Field of Sound Consciousness

The need for universal and clearly defined words with which to describe equipment, tests, and conditions in the field of sound, or acoustics as it is technically called, became acute about twelve to fifteen years ago. The general introduction and commercialization at that time of public address systems, radio broadcasting, and new types of phonographs, as well as an awakening interest in noise and its abatement, brought together engineers, physicists, and musicians, each group with a technical vocabulary not fully understood by the others.

A step towards the solution of this babel was

ASA Unites Many Groups in Agreement on Standard Terms

Radio, railways, cities, motion pictures, acoustical materials, gas and electric companies, medical groups, and the War Department are some of the varied interests which have a stake in the problem of acoustics and are represented on the Sectional Committee on Acoustical Measurement and Terminoloy (Z24) under the administrative leadership of the Acoustical Society of America. Members of the committee are:

V. O. Knudsen*, Acoustical Society of America, *Chairman

J. W. McNair*, American Standards Association, *Secretary

Acoustical Society of America, *Harvey Fletcher, H. A. Frederick, V. O. Knudsen, D. C. Miller*
Acoustical Materials Association, *John S. Parkinson, Wallace Waterfall*
American Gas Association, *F. E. Vandaveer*
American Institute of Electrical Engineers, *P. L. Alger, C. R. Hanna, Bassett Jones, B. F. Bailey (alt.), Ellsworth D. Cook (alt.), H. M. Turner (alt.)*
American Institute of Physics, *Henry A. Barton*
American Medical Association
American Otological Society, *Edmund P. Fowler*
American Physical Society, *Henry A. Barton*
American Society for Testing Materials, *R. E. Hess*
American Society of Civil Engineers, *S. E. Slocum*
American Society of Heating and Ventilating Engineers, *Carl M. Ashley, P. D. Close (alt.)*
American Society of Mechanical Engineers, *D. E. Free, R. V. Parsons, William Braid White, Paul H. Bilhuber (alt.), John S. Parkinson (alt.), Harry S. Read (alt.)*
American Transit Association, *H. S. Williams*
Canadian Engineering Standards Association, *George S. Field*
Electric Light and Power Group, *R. N. Conwell, H. E. Kent (alt.)*
Institute of Radio Engineers, *Ellsworth D. Cook, Irving Wolff*
International City Managers' Association, *E. C. Rutz*
Music Industries Chamber of Commerce, *Paul H. Bilhuber*
National Association of Fan Manufacturers, *A. A. Criqui, J. L. Lennon (alt.)*
National Electrical Manufacturers Association, *L. W. Chubb, A. Pinto, J. J. Smith, C. R. Boothby (alt.), J. A. Jackson (alt.), H. M. Williams (alt.)*
Radio Manufacturers Association, *Hans Roder*
Research Council of the Academy of Motion Picture Arts and Sciences, *Nathan Levinson*
Society of Automotive Engineers, *R. F. Norris, Stephen J. Zand*
Society of Motion Picture Engineers, *Franklin L. Hunt, S. K. Wolf*
Telephone Group, *R. G. McCurdy, A. F. Rose (alt.), W. H. Martin, Arthur Bessey Smith, R. H. Manson (alt.)*
U. S. Department of Commerce—National Bureau of Standards, *V. L. Chrisler*
U. S. Navy Department, Bureau of Engineering, *Officer in Charge, Specification Section, Design Division; Laboratory officer (alt.)*
U. S. War Department, *Stewart W. Stanley*
Members-at-Large, *F. A. Firestone, P. E. Sabine, Leopold Stokowski, Wallace Waterfall, F. R. Watson*

taken by the Institute of Radio Engineers by appointing a committee to provide a glossary of terms and definitions used in radio engineering and its associated fields. The resulting report contained about 40 terms relating to acoustics and electro-acoustical instruments, and proved to be of real value to the industry.

This report, however, soon proved inadequate in coping with the many acoustical problems of the rapidly developing science which began to involve the studio and the theatre in the rapid development of sound pictures. The then newly organized Acoustical Society of America recognized this need and in December, 1929, appointed a committee to consider the standardization of acoustical terminology.

Hope for International Use

After this committee had published its report containing the definitions of about 150 terms, it was thought desirable to continue and extend the work through the broad membership of the American Standards Association in order to develop terms and definitions which not only might receive recognition in this country but also might lead to universal adoption of suitable standards.

A new committee was formed around a nucleus of members from the older committees. The results of several years of labor by this group, collecting data, criticisms, and comments, have just been published as an American Standard Z24.1-1936.

The task undertaken was to define the terms used in the various branches of acoustics, in order to reduce the confusion which has existed due to the use of a single term to represent different concepts or of several terms to represent the same concept. The definitions were to conform wherever possible to the current use of the term by the majority of workers and writers in this field. Due consideration was to be given not only to American usage but also to foreign usage of terms. Throughout the study, contact was maintained with the standardizing bodies of other countries. Terms were to be defined in a form which would make them of the most practical use. Mathematical forms of definitions were avoided where possible in favor of concise word statements even at the expense of complete generality. The use of one name for more than one concept was avoided where possible.

The list which has been approved contains 152 terms defined in accordance with the above conditions. The arrangement has not been the alphabetical one of a dictionary but rather a grouping according to subject, thereby permitting a logical development of the subject with practically no necessity for referring to subsequent definitions.

Courtesy Bell Telephone Laboratories

The safety of the fishing fleet may depend upon this telephone system—one of the types of appliances for which standard terminology will be used.

The first of the six sections contains those general terms which are necessary for accurate exposition in any subdivision of the field of acoustics. Here are found definitions of the fundamental expressions of wave motion such as "periodic quantity," "fundamental frequency," "basic frequency," and many others.

The committee here avoided an impasse reached

Experts Propose Standard Terms

A working subcommittee of experts was appointed by the general sectional committee to prepare first drafts of standard acoustical terms. Members of this subcommittee are:

H. A. Frederick, Bell Telephone Laboratories, *Chairman*
Paul H. Bilhuber, Assistant Factory Manager, Steinway & Sons, Long Island City, N. Y.
C. W. Hewlett, General Electric Company, Schenectady, N. Y.
W. H. Martin, American Telephone & Telegraph Co., New York
Irving Wolff, RCA Victor Co., Camden, N. J.
V. L. Chrisler, National Bureau of Standards, Washington, D. C.
R. V. Parsons, Johns-Manville Sales Corp., New York
C. F. Wiebusch, Bell Telephone Laboratories, New York, *Secretary*

by some of the other standardizing bodies. There is a real problem if the "fundamental frequency" is defined as the lowest component frequency of a periodic wave because we are forced to recognize the existence of sub-harmonics. We may not evade the question by the omission of the former and more important of the two definitions. This problem was met by setting up the new term "basic frequency." The "basic frequency" of any wave is defined as that frequency which is considered to be most important. In a driven system it would in general be the driving frequency while in most periodic waves it would correspond to the fundamental frequency.

Sub-harmonics, which in general appear only in driven systems, such as loudspeakers, and inharmonic partials can be expressed relative to a "basic frequency" rather than to a fundamental. The latter has always been considered by both mathematicians and engineers to correspond to the lowest frequency component of a periodic function. A few of the terms included in this section such as "decibel" and "periodic quantity" appear in American Standards adopted earlier by other groups and these have been reprinted without change.

The word "bar" used as a unit of pressure equal to one million dynes per square centimeter or approximately equal to atmospheric pressure has been in use by meteorologists and others for many years. About fifteen years ago, however, the word began to appear in the literature on acoustics to mean one dyne per square centimeter. It seems confusing and unwise to usurp the use of a long-established unit of another science, particularly with a radically changed magnitude. For this reason it was thought advisable to use the much longer but fundamental expression "dyne per square centimeter" as the unit of sound pressure and to deprecate the use of the term "bar" with the same meaning. Perhaps at some future time a new word or an abbreviation may be used to represent this rather unwieldy expression as has been done by some writers who use the word "barye." The word "microbar" is another possible choice consistent with the older use of the word "bar," but there might be a tendency to confuse it with one-millionth of a dyne per square centimeter.

Noise — An Unwanted Sound

Practically all elementary textbooks of physics define noise as a sound produced by an irregular succession of vibrations and hence one to which no definite pitch can be ascribed. This is generally contrasted with a musical sound or a sound which does give a definite pitch sensation. This definition does not agree with the practical conception of a noise, particularly as the subject is coming to receive more attention in connection with efforts for noise abatement. There is a rapidly growing tendency to classify as noise any sound which is objectionable at the particular time and place regardless of its physical characteristics. Because of this shifting interest and emphasis the committee decided to frankly face a very practical situation and define noise as any undesired sound. Thus the term "noise" cannot be taken as a description of a sound but rather as a statement of a particular listener's reaction to the sound under the existing circumstances. To represent the concept which the older physicists termed "noise," a new and highly descriptive term "unpitched sound" has been set up.

Acoustics and the Architect

The second section deals with Architectural Acoustics. Work in this branch has been largely on an empirical basis with a terminology based on the experimental technique used. During the last few years, however, investigations of architectural acoustics and the materials used in architecture have taken on a much more fundamental character. There has been a tendency on the part of investigators and authors to attempt to adapt the older terminology to their broadening needs with the result that the literature tends to lack clarity and definition. To improve these conditions the committee sought the cooperation of the

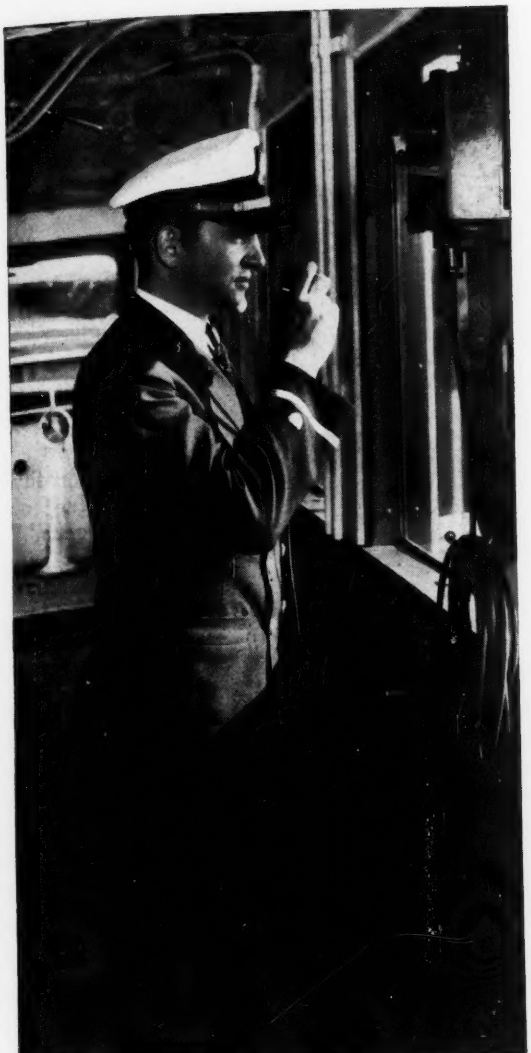

Photo by Morris Rosenfeld

With this loud-speaking device, which makes his voice equivalent to that of half a million men, this officer can direct the operations of a fleet.

leading engineers and physicists in this field to aid in formulating a set of terms and definitions on an exact and scientific basis. At the same time, some of the older terms were included, retaining for them their original meaning as far as possible but limiting this meaning to only one accurately specified concept.

Whereas all absorption and reflection measurements must be made on samples of limited size and hence will be influenced by the size and distribution of the sample pieces, it is obvious that unless the results can all be correlated to apply to the case of an infinite sample in which the disturbing edge effects are negligible, they cannot be said to represent a property of the material.

The terms "acoustic reflectivity" and "acoustic absorptivity" will specify actual properties of the material, and if this material is to be used in a

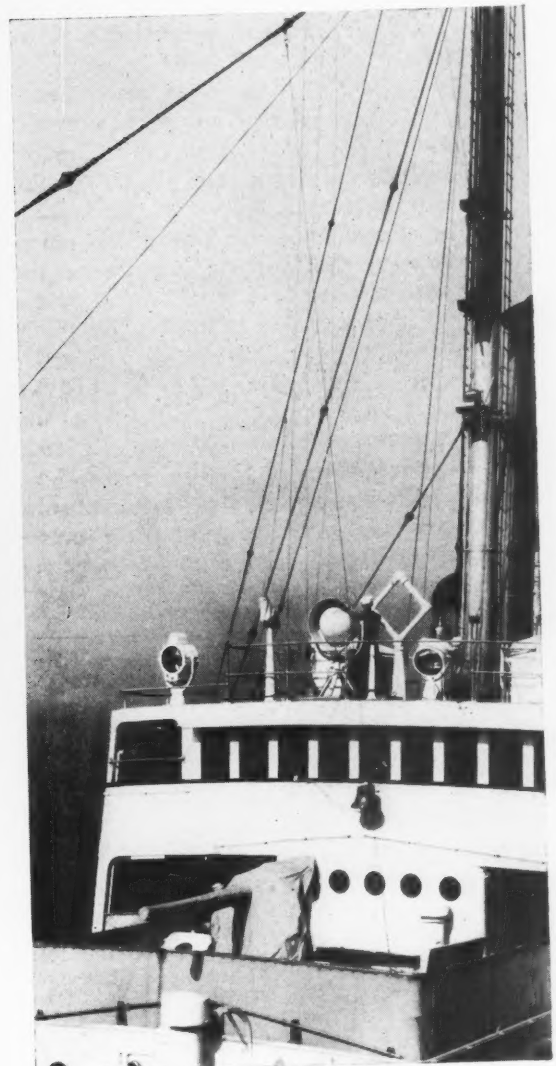

Photo by Morris Rosenfeld

And this is how his orders are received. The United States Navy was represented on the committee which proposed the standard acoustical terminology.

Sound Measurement and Meters Based on Standard Terminology

THE work of the Committee on Noise Measurement in developing standard definitions for acoustical terms has become the basis for two important standards on sound measurement—the American Tentative Standard for Sound Level Meters (Z24.3-1936) and the American Tentative Standard for Noise Measurement (Z24.2-1936).

The variety of interests represented in any standards program under the American Standards Association makes a definition of terms the first essential for agreement.

The Committee on Noise Measurement found this particularly true in the case of a science as new as that of acoustics. Careful thought had to be given each definition and each term in order that words from other fields, with slightly different meanings, might not slip into the language for the new science and cause confusion in the future.

For this reason the standards on noise measurement and sound level meters have been based on the newly approved standard for acoustical terms.

sound-treating installation, factors must be introduced in the calculations to correct for the effect of the geometry of the enclosure and the placement of the material. On the old basis the designer not only would have had to know these conditions but also the conditions under which the test on the material was made. It also would have been impossible to rate different products unless measured in the same way or unless the results were first reduced to a common basis.

Measuring Hearing

The third section concerns hearing. It includes those terms having to do with sound as a sensation. The study of this, perhaps the oldest branch of acoustics, had from a qualitative standpoint a well developed terminology. It has been only recently, however, that the science has advanced far beyond the "listening to a watch tick" stage. Thanks to the high state of development of electroacoustic instruments it is now possible to measure the performance of a person's hearing equipment with considerable precision.

Scientific progress requires the accurate definition as well as measurement of all these characteristics. This is necessary for the proper design of communication apparatus for persons of normal hearing and also for the design or selection of hearing aids for those having sub-normal hearing.

It is necessary to have a vocabulary of accurately delimited terms. For this purpose there are such terms as "threshold of audibility," "percent hearing loss" and "equivalent loudness."

On the other hand for such a popular subject there is need for words of a more general and yet definite meaning. The word "loudness" comes under this latter classification and is defined as follows: "the loudness is that subjective quality of a sound which determines the magnitude of the auditory sensation produced by that sound." This term is broad enough to be but rarely misused as it undoubtedly would be if the definition were narrowed down to the point where it became of more specific scientific value.

The expression "equivalent loudness" serves in those cases where a quantitative specification of a particular property of a sound is desired. The equivalent loudness of a sound is expressed in terms of the intensity level of a thousand cycle pure tone which is judged by a group of listeners to be equivalent in loudness, and is expressed in decibels. The conditions under which the listening is to be done are accurately fixed.

It is also possible to build a calibrated electroacoustical measuring set, the readings of which, for most sounds, will be in fair agreement with the listening tests as mentioned above. The characteristics of these "sound level meters" have been described by R. G. McCurdy in the April, 1936, issue of INDUSTRIAL STANDARDIZATION.

Another group of words related to hearing are those associated with the transfer of information, especially in communication apparatus. Here are found such expressions as "discrete sentence intelligibility" and "syllable articulation."

The development of that portion of acoustics relating to the association of electricity and sound has been particularly rapid in the last few years. The conversion of electrical energy into sound or the reverse process must in general take place through an intermediate conversion into mechanical energy.

Language of Acoustics Borrows from Other Fields

In the final analysis, of course, theoretical acoustics is but a branch of mechanics, the mechanics of statistically continuous media. Many of the laws governing acoustical and mechanical

systems are of the same form as those governing electrical systems. During the latter part of the nineteenth and the early part of the twentieth centuries rapid advances were made in the theory of electrical transmission, and although it has perhaps led to some awkward situations, it was to be expected that the development of the theory of mechanical and acoustical transmission should follow along the same path.

Such terms as "acoustics impedance," "acoustic reactance," and "mechanical reactance" defined in the fourth section, bear witness to the influence of electrical theory on that of acoustics. Some persons have objected to this borrowing of terms with only a modifier as a distinguishing feature and in some cases with even the word "acoustic" omitted. Such omission is deprecated in any case of possible misinterpretation. However, the choice of the complete terms themselves leads to a very active appreciation of the close analogy between the electrical and acoustical problems and performance and for that reason appears commendable.

The relation in which these quantities appear have the same mathematical forms in the three systems if velocities or volume velocities are replaced by currents, and forces or pressures are replaced by voltages.

It is this similarity which led to the pedagogically useful mechanical analogies of electric circuits and to the later fruitful electric equivalences of mechanical and acoustical systems. The similarity of the terms leads a student of one of the branches to a feeling of familiarity with the others and to facility in reading the literature of these others. The borrowing of terms has not been entirely one sided. The use of "resonance" and "free vibration" in the study of sound and mechanical oscillations antidated by many years their popular adoption by those interested in electricity.

The reader of some of the literature on vibrations is often confused by the term "resonance," because, in one place it refers to the condition of maximum velocity response, at another, it may refer to a condition of maximum displacement response. In the standards, the first concept has been permitted to retain the name "resonance," whereas the second, and perhaps less frequently used concept, has been called "displacement resonance." Because of the importance of these two concepts, especially as applied to a system of one degree of freedom, more discussion than usual has been added and equations are included relating the velocity, displacement, and phase to the stiffness, mass, and resistance of the system.

The fifth section bears the title "Transmission Systems" and defines various types of acoustic filters and transducers. These terms are rarely misused but have been included here for reference purposes and for completeness.

"Noise" Is Objectionable

"Noise" has a new definition now that the work of the Sectional Committee on Noise Measurement in defining acoustical terms is completed. Most textbooks define noise as a sound produced by an irregular succession of vibrations and hence one having no definite pitch. The new definition classifies "noise" as an undesired sound. "Unpitched sound" is the new term which describes the original concept of noise.

Science and Art Unite

The sixth section deals with Music. This section had a slightly more complicated history than the others because this subject concerns not only a science but an art as well. The terms and the concepts must be those of the musician, and in addition they must be expressed in a manner acceptable to scientists. There can be no question that, at this time, such a list of definitions is very important because of the growing cooperation between engineers and musicians—in their effort to furnish entertainment through the sound pictures and the radio, for instance. To accomplish the desired result a subcommittee under the chairmanship of P. H. Bilhuber, Assistant Factory Manager, Steinway & Sons, was formed to compile a suitable list of definitions. All the members of this committee have a wide knowledge of music and musical instruments and were eminently fitted for the task. The final list as adopted contains sixteen definitions and three tables listing the intervals of a just and tempered scale and the frequencies of the equally tempered scale based on the American Standard pitch of 440 cycles. The list includes only those terms on which reasonably complete agreement is possible at this time and can be said only to represent a foundation to which others may be added as necessity may dictate.

A terminology standard should be a living thing, growing with advances of our knowledge and practice. Since scientifically applied acoustics is so new, we must expect our need for terms and our concepts to develop and grow. This list should be flexible and adapted to such growth. Such growth and development of acoustics will be fostered by the accurate and uniform use of the best terms known.

Standard Terms for Music Unite Art and Science

Standard pitch, confirmed by American Standards Association as national basis for music scales and instrument tuning, saves one instrument manufacturer loss of quarter million dollars in factory changes

Standard terminology gives engineers, acoustical scientists, and musicians common language to solve new problems in radio and sound motion pictures

by

Paul H. Bilhuber[1]

Chairman, Subcommittee on Musical Terminology Sectional Committee on Acoustical Measurement and Terminology

and

William Braid White[2]

Secretary, Subcommittee on Musical Terminology

RELATIONSHIP between the art of music and the science of mechanics may seem, at first thought, like a contradiction in terms. In reality, however, the relations are close, and should be closer.

Music requires standards just as definite and as generally accepted as the making of machine parts, the measurement of power, or the use of weights and measures.

Music depends upon instruments for its expression. It can come into objective existence only as it is performed by means of instruments (which term includes the human voice). For this reason the study of the sounds used in music and produced by musical instruments has engaged scientific minds for three hundred years and more. Because a scientific discipline (musical acoustics) has necessarily underlain all serious work in developing the musical art as a means of expression, it is inevitable and also highly important that scientific standards, to bring about precision in both the physical units of the science and in the language which is used to describe them, should be worked out and adopted both in the science and in the art of music.

Musical art, as we practice it today, finds its

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[2]Acoustic Engineer, American Steel & Wire Company, Chicago.

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ASSISTANT MANAGER

In the America of the future radio and motion pictures will be important in developing our civilization. For this we need a complete understanding between engineers and musicians. Their technical terms must be the same, then they can exchange ideas and understand each other completely, so that when they work together it will be in perfect harmony.

Leopold Stokowski

foundation in the scales of sounds worked out by the mathematicians and philosophers of classical Greece, beginning with Pythagoras (7th Century B.C.). If any art is to be a coherent and intelligible means of expression, it must have what may be called fundamental units. Thus, in poetry these are the words of the language grammatically organized. In painting they are the spectrum of the colors. In music they are the scale of musical sounds.

Scales, or series of standard sounds, as worked out by Pythagoras and his successors, depended upon the establishment of simple arithmetical ratios, based upon measurements of the lengths of strings required to produce these sounds, each to each. From simple beginnings the Greeks worked up an elaborate set of such scales. They had no sense of harmony, that is, the art of combining simultaneous musical sounds; and all their music appears to have been simply melodic, consisting of series of sounds evoked according to the different ratios set up in the different scales. Modern music has dropped this company of scales, retaining only two of the many. On these it builds its ideas of melody. It has, however, developed the art of combining simultaneous melodies (counterpoint), and the sister art of building blocks of simultaneous sounds to support and form a framework for the melodies (harmony).

The major and minor scales of western music, drawn from Greek models, have now been still further simplified by the universal adoption of the so-called Equal Temperament. This is actually a system of tuning which simplifies all the strict mathematical ratios originally derived from the Greeks to a single ratio, the octave. A ratio for adjacent sounds (semitones), immediately derived from it, is also provided. This simplification was necessary because the original mathematical ratios became unmanageable with the intrusion of additional members of the scales in the shape of the so-called sharps and flats.

Standard Tuning Possible

Because all musical instruments of fixed pitch today are made to accord to Equal Temperament tuning, it is highly important that the actual number of sound-vibrations required to evoke each of the members of the equal-tempered semitone scale should be precisely determined and their values made known. Otherwise it would be impossible to have any standard system of tuning, and no two musical sounds, even though they might bear the same name and be represented by the same sign in notation, would actually be alike.

This becomes clear when we consider that each

Courtesy American Steel & Wire Co.

Testing the effect of the musician's touch. For a good piano "tone" the wire must be hard enough and dense enough to ensure adequate tensile strength (320,000 to 375,000 lb per sq in.) and still be highly elastic. The musician and engineer can now talk a common language in making such tests as this.

(Rudolph Ganz is shown here registering his touch on a piano keyboard at the Acoustic Laboratory of the American Steel & Wire Company. The apparatus at the right of the piano is making a photograph of the sound waves evoked by Dr. Ganz as he presses the key of the piano.)

and every sound is the product of the movements of some suitable body, such as a string, the tongue of a reed, or the column of air enclosed in a tube. The pitch of a sound, as it is called, depends upon the number of these oscillatory movements executed in a given time. It is obvious, therefore, that if we are not to have continual confusion we must decide that the basis of our scales shall be some definite sound, definitely produced by a definite number of sound vibrations of a suitable body, in some chosen unit of time.

The necessity for a standard of pitch has always been recognized. Unfortunately, in the past its attainment has been impossible on any large scale, owing to national prejudices, the indifference of the rank and file of players and singers, and the lack of an educated public. During the last twenty years, however, the pressure to settle the question once for all has been irresistible, and what has now been done by the American Standards Association is in effect the culmination of a movement long in being and which came to a climax in the year 1925. At that time the associated music industries of the U. S. A., after a committee of scientists and technicians appointed by them had thoroughly studied the question, agreed that a sound produced by 440 vibrations per second of a suitable tuning fork should be

regarded as the one and only true A (49th key upward from the bass end of the piano keyboard) and that all scales, all tuning, and all playing should henceforth be conducted from that as a basis and foundation. The American Standards Association has now brought in engineers and acoustical experts to confirm this as a national standard. Indeed it is now becoming more generally accepted than any other as the practice of the western world today.

Standard Routs Confusion

The importance of this is enormous. To take one example, in the manufacture of so-called wind instruments, the length of the tube determines the frequency of the fundamental musical tone to which each such instrument is tuned. Wood winds, in particular, are not easily remodeled for pitch change. When, therefore, there is no standard of pitch universally adopted, each manufacturer is obliged to adopt one for himself, and although there has, of course, usually been a fairly close agreement in such cases, there has never been certainty. Confusion, more or less dangerous and damaging to musical performance, has in fact been the rule in the past, rather than the exception.

Now, with the adoption of a universal standard, each manufacturer of a wind instrument can adapt his machines and his methods to mechanical standards based upon the musical standard. During the investigation of the pitch question in 1925 one famous manufacturer of brass instruments showed facts and figures to support his statement that if he were to be obliged once more to change his pitch standard, he would have to invest a quarter million dollars in mechanical changes in his factory. It was fortunate in his case that the practice he had adopted virtually coincided with the recommendations of the investigating committee.

In another musical region, that of singing, the adoption of a universal standard is a matter of decisive importance. Singers can learn to produce a certain limited scale of musical sounds, above or below which their voices cannot and will not reach. When there is no standard of pitch, every singer may at any time find himself

Standard Pitch Helps Singers, Instrument Makers and Users

"The American Standards Association has brought in engineers and acoustical experts to confirm the standard 'A'—440 vibrations per second—as a national standard.

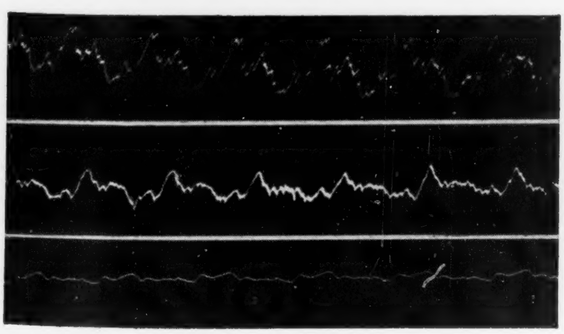
"Confusion more or less dangerous and damaging to musical performance has been the rule in the past rather than the exception.

"Now each manufacturer of a wind instrument can adapt his machines and methods to mechanical standards based upon the musical standard.

"In singing, the adoption of a universal standard is of decisive importance. . . . If the pitch of an orchestra or piano to which a singer is to sing at a concert is different from the pitch of the instrument by which the part or song has been studied, the voice may be strained.

"In the case of the piano, an increase of five cycles per second in the frequency of the standard A, with a corresponding change throughout the entire scale, would throw an additional strain of something like half a ton on the framework of the instrument. Naturally the manufacturers of pianos are definitely interested in knowing what the standard of pitch is and will be in the future."
—Paul H. Bilhuber.

What the sound-recording apparatus picked up when the musician struck C (65 cycles per second). (Top). Powerful stroke bringing out from the string many harmonics. A rich, strident quality of tone was the result. (Center). Moderate stroke bringing out only the lower, more agreeable harmonics. A tone of a mellow quality was the result. (Bottom). Very weak stroke, bringing out only 2 or 3 low harmonics very faintly. A tone with a faint, sweet quality resulted.



Personnel of ASA subcommittee which developed the standard on musical terminology:

Paul H. Bilhuber, Steinway & Sons, *Chairman*
Otto Ortman, Peabody Observatory of Music
A. T. Jones, Smith College
John Redfield, Engineering Consultant in Musical Acoustics
Wm. Braid White, Acoustic Laboratory, American Steel & Wire Co.

or herself called upon to produce tones too high or too low for his or her particular voice; even though the printed music shows no change. For if the pitch of an orchestra or a piano to which the singer is to sing at a concert is different from the pitch of the instrument by which the part or the song has been studied, the voice, under extremes of this condition, may be strained. This is particularly true of singers with a highly developed sense of pitch.

In the same way, consider the case of the piano. An increase of five cycles per second in the frequency of the standard A with, of course, a corresponding change throughout the entire scale of the piano would throw upon the framework of the instrument an additional strain of something like half a ton. Naturally, the manufacturers of pianos are definitely interested, even from a purely mechanical point of view, in knowing what the standard of pitch is and will be in the future.

Similar considerations apply to the design and construction of organs. They even apply to the much simpler case of the violin family of instruments, for here, although the players tune their own strings, the question of what stresses these set up when they are in tune is a matter of considerable importance both mechanically and aesthetically.

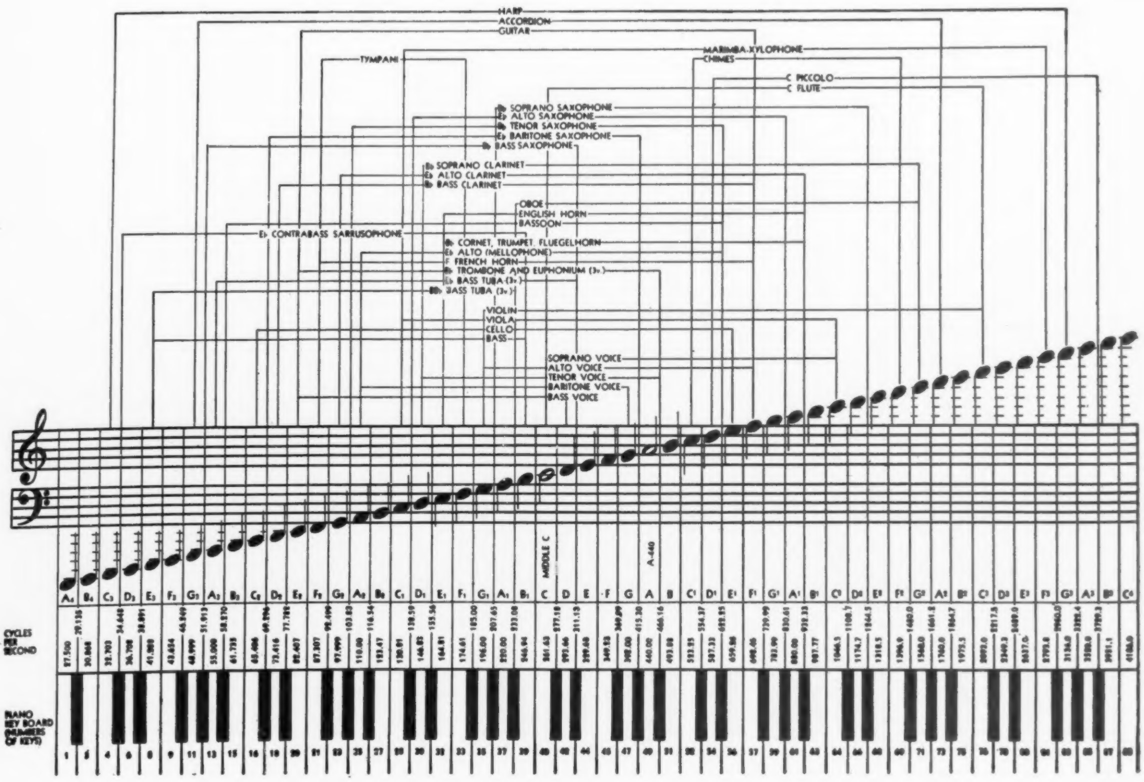
Radio Brings Problems

The electrical requirements of radio transmission and reproduction of music have brought numerous new and important problems before the designers and the players of musical instruments. These problems can only be solved if and when the electrical engineers and acoustical scientists on the one hand, and the practical musicians on the other, shall have come to agreement on their exact nature. This, in turn, depends at first and principally upon the ability of these different groups to formulate the problems and the data on which these must be worked out in terms intelligible to both groups and understood by each in one meaning. The standard definitions thus serve two purposes: They clear up for the electrical engineer and the physicist the mathematical and mechanical nature of the units used in the art of music, at the same time, they assure musicians that these units will be properly understood by those who are concerned with transmitting and reproducing music.

This is, of course, equally true in the art of sound recording and reproduction for moving pictures. The problem of fitting together the existing, and necessarily permanent, features of musical performance — orchestras, instruments, their necessary conventions, etc.—with the needs

Table shows frequencies of the tones of the equally tempered scale as used in music, named and numbered according to their positions on the pianoforte keyboard and calculated according to the American Standard Pitch.

Name on Pianoforte Keyboard	*1st Octave No. Cycles Per Second*	*2nd Octave No. Cycles Per Second*	*3rd Octave No. Cycles Per Second*	*4th Octave No. Cycles Per Second*	*5th Octave No. Cycles Per Second*	*6th Octave No. Cycles Per Second*	*7th Octave No. Cycles Per Second*	*8th Octave No. Cycles Per Second*	*Name on Pianoforte Keyboard*
A	1 27.500	13 55.000	25 110.000	37 220.000	49 440.000	61 880.000	73 1760.000	85 3520.000	A
A♯ — B♭	2 29.135	14 58.270	26 116.541	38 233.082	50 466.164	62 932.328	74 1864.655	86 3729.310	A♯ — B♭
B	3 30.868	15 61.735	27 123.471	39 246.942	51 493.883	63 987.767	75 1975.533	87 3951.066	B
C	4 32.703	16 65.406	28 130.813	40 261.626	52 523.251	64 1046.502	76 2093.005	88 4186.009	C
C♯ — D♭	5 34.648	17 69.296	29 138.591	41 277.183	53 554.365	65 1108.731	77 2217.461		C♯ — D♭
D	6 36.708	18 73.416	30 146.832	42 293.665	54 587.330	66 1174.659	78 2349.318		D
D♯ — E♭	7 38.891	19 77.782	31 155.563	43 311.127	55 622.254	67 1244.508	79 2489.016		D♯ — E♭
E	8 41.203	20 82.407	32 164.814	44 329.628	56 659.255	68 1318.510	80 2637.021		E
F	9 43.654	21 87.307	33 174.614	45 349.228	57 698.456	69 1396.913	81 2793.826		F
F♯ — G♭	10 46.249	22 92.499	34 184.997	46 369.994	58 739.989	70 1479.978	82 2959.955		F♯ — G♭
G	11 48.999	23 97.999	35 195.998	47 391.995	59 783.991	71 1567.982	83 3135.964		G
G♯ — A♭	12 51.913	24 103.826	36 207.652	48 415.305	60 830.609	72 1661.219	84 3322.438		G♯ — A♭



C. G. Conn, Ltd.
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The frequency in cycles per second of each note in the standard scale and the range covered by each band and orchestra instrument and the human voice are charted here, showing their relation to the piano keyboard.

both of the electrical apparatus and of the places in which the combined results are ultimately to be heard, demand that producers and reproducers of music speak a common language and act in sympathetic collaboration.

The case of musical instruments has already been touched on. It is only necessary to add here that the science of designing and the art of constructing the complex musical instruments required today for musical performance stand to gain everything from investigations which have led to formulating standards of meaning, of unit, and of measurement, upon a physical basis, in all that relates to the production of musical sound. Whatever makes for greater precision, for standard units, and for standard physical properties, makes also for the good of the manufacturer of musical instruments and thus for the good of the consumer.

The acoustical engineer has placed at the disposal of the musician and the musical instrument manufacturer certain new tools, but it must not be supposed that the science of acoustics has just been discovered by the electrical and radio engineers. There has been a science of sound for centuries and the units it has set up, and its standards, are fundamentally important.

Engineers, Musicians Cooperate

It is the electrical engineers who have now become involved in the science and art of music by reason of the development of radio and sound pictures, and it is rather their business to adapt themselves to the framework of a complex, highly organized, and long-established art. The movement for music terminology standards has, in fact, been based upon this understanding. The close cooperation between engineers and musicians in the past year or two has been most encouraging.

On the other hand, the science and art of music can utilize the apparatus of the new electro-acoustics to considerable advantage. This apparatus is far better able to deal with the very small energies developed during the emission of

Broadcast Standard Pitch

The standard "A", 440 vibrations per second on a suitable tuning fork, confirmed by industry, science, engineering, and musicians through the American Standards Association, is now the standard basis for tuning musical instruments.

As a scientifically accurate tuning instrument, the National Bureau of Standards has broadcast the standard "A" on frequencies of 5,000, 10,000 and 15,000 kilocycles per second, simultaneously. Musicians, musical instrument manufacturers, and piano tuners have benefitted through this broadcasting of accurate pitch.

musical sounds, than were the comparatively crude mechanical devices available before the advent of electronic methods.

Electrical Apparatus Used

A few of the special uses to which electro-acoustic apparatus has been adapted in the science and art of music are the following:

Investigation of the physics and mechanics of musical instruments, especially of the piano and of the violin family, both here and abroad.

Investigation of the relation of the pianist to the pianoforte, in the matter of touch and tone.

Application of cathode-ray and stroboscopic methods to the problem of measuring the tuning of musical instruments.

Application of the same cathode-ray and other oscillographs and oscilloscopes to the study of the quality of musical sounds given out by musical instruments and the voice.

The definite tables of musical frequencies prepared by the American Standards Association will, of course, serve to set up standards of musical pitch for years to come, and will at the same time furnish the designers of musical instruments with standards on which to base their calculations and their engineering. Moreover, students in musical science, working upon possible new musical scales, and on other investigations dealing with the more learned branches of musical composition, the theory of musical harmony, etc., will find these standard tables invaluable.

The fact that the standard frequencies have necessarily been built upon the system of tuning in equal temperament will probably direct attention to defects which undoubtedly exist in the system, despite its convenience, and may perhaps lead to studies which will result in its improvement or in its being superseded by some better system not yet invented.

Industry Accepts Plywood Standard

The Commercial Standard for Douglas Fir Plywood has been accepted by all interests of the industry and is now being promulgated by the National Bureau of Standards. The standard for this commodity has been issued in the form of two separate documents, one for domestic grades, which is designated as CS45-36, and the other for export grades, which is designated as CS45E-36.

The standard has been revised to include the experience of the past three years and clarifies the grades to insure a better product to distributors and consumers.

Mimeographed copies of the commercial standards may be obtained from the Division of Trade Standards, National Bureau of Standards, Washington, D. C., until such time as the printed editions become available.

Machine Tool Builders Elect Clayton Burt President

Clayton R. Burt, president, Pratt and Whitney Division, Niles-Bement-Pond Company, was elected president of the National Machine Tool Builders' Association at its annual meeting October 5-7. Mr. Burt has been active in the national standards program as a member of the Board of Directors and of the Standards Council of the American Standards Association.

The National Machine Tool Builders' Association is a Member-Body of the American Standards Association, and as such has an active part in determining its policies and in approving national standards.

New Standard for Installing Sprinkler Equipments

A new edition of the standard Regulations for the Installation of Sprinkler Equipments, incorporating amendments adopted by the National Fire Protection Association in 1936, has been made available. Copies may be obtained from the N.F.P.A., 60 Batterymarch Street, Boston, Mass.

Comparison of Methods Paves Way For International Fading Tests

An attempt was made recently, as a preliminary step toward the establishment of an international system, to compare the methods of measuring fastness-to-light of textile fabrics used by the Society of Dyers and Colorists in Great Britain, the Association of Textile Chemists and Colorists in the United States, and the Fastness Commission in Germany. The attempt at comparison was made by the Textile Research Institute at Dresden.

The systems of these three organizations are somewhat similar, says a report on the tests published in the *Manchester Guardian*, September 11.

The standards of comparison in all systems are based on a series of dyeings on wool, because on wool fiber the results are most constant. The Germans, however, dye to one shade with dyes giving eight different degrees of fastness; the British have two series of eight types of dyeing, the one blue and the other red; the American series is simply six dyeings to different shades.

In the Dresden tests the samples were simultaneously exposed first to sunlight and then to accelerated fading by a special lamp, the intensity of which was 18 times that of sunlight. A separate table was then drawn up for each of these methods of exposure showing the number of hours' exposure necessary for each sample before it commenced to fade.

The English samples, whether blue or red, corresponded very closely in behavior to the German blue samples, except in one instance, where the difference was inexplicable. Placed in order the samples had a fastness range of 1, 3.5, 6, 20, 40, 70, and 100 hours. The American scale did not correspond at all with the other two, and the fastnesses were not so regularly spaced.

"One interesting point brought out in the tests," says the *Manchester Guardian*, "was that there was a tendency for certain shades, particularly red, to bleach slightly during the first few minutes of exposure, after which the samples recovered their original shade. This seems to imply that any international standards decided on should be confined exclusively to the blue shades."

Engineering Foundation Elects Farmer Chairman

F. M. Farmer, vice-president and chief engineer of the Electrical Testing Laboratories, New York, and newly elected chairman of the ASA Standards Council, has been elected chairman of the Engineering Foundation, research organization of the national engineering societies. Mr. Farmer, an authority on electrical measurements, electrical insulating materials, testing of engineering materials, and high-voltage cables, succeeds H. P. Charlesworth, assistant chief engineer of the American Telephone & Telephone Company.

Mr. Farmer is a past-president of the American Society for Testing Materials and of the American Welding Society. He is a member of the engineering division of the National Research Council and of the Electrical Standards Committee. He is a fellow and director of the American Institute of Electrical Engineers, a fellow of the American Association for the Advancement of Science, and a member of the American Society of Mechanical Engineers and the Institution of Electrical Engineers (British).

Dr. Robert Yarnall, member of the firm and chief engineer, The Yarnall-Waring Company, Philadelphia, was re-elected vice-chairman by the Engineering Foundation.

World's Standards Activities Surveyed in New Report

The World Power Conference, as one step in its standardization program, has just made public a survey showing the present development of national and international standardization.

The standardization functions of the Conference are to provide a forum for the preliminary discussion of such questions; to suggest to the standardization bodies concerned, either national or international, matters which seem ripe for standardization; and to act as a clearing house of information on standardization work already achieved for the benefit of its National Committees and their members.

National standardization has reached a high degree of organization, the Conference report indicates, but by contrast, international standardization falls short of reaching the same level of effectiveness, and shows signs of duplication and overlapping of effort.

Standardization Essential For Efficient Motor Corps,

Army Believes

THE Quartermaster Corps, which does the buying for the Army, now contemplates specifying dimensional standards to make possible the interchange of units of vehicles of different makes and models, in addition to specifying certain standards of performance and construction.

Standardization of motor vehicles used by the Army is, according to many authorities within the service, the ultimate goal, and specification of dimensional standards is a step in that direction.

Supporters of the plan point to the Army's experience in the World War, when it was equipped with innumerable makes and models of trucks and ambulances. A unit out of commission was disabled indefinitely, or until parts could be brought from distant points to repair it. With complete standardization, they point out, this need not happen: one vehicle can be dismantled and used to repair half a dozen others immediately and on the scene of the casualty, or a small stock of unit assemblies maintained in the forward area will provide for keeping a maximum number of vehicles in working order.

Writes in Specifications

The Army must buy from the lowest bidder, as provided by law. And it has, it appears, gone as far as it can in standardizing its equipment by writing into its invitations for bids various specifications.

Under the statute and under decisions of the Comptroller General, it would be unlawful to make complete dimensional specifications. This procedure, it has been ruled, would be equivalent to specifying the product of only one manufacturer.

Proceeding in another direction, Army men have suggested assembling their own equipment from parts manufactured by the industry, as a solution of the standardization question.

"To this proposal there has been much dissent," says the *N. Y. Herald-Tribute*, November 15.

"In the first place, it appears that there is an active prejudice against assembled vehicles. The development of pleasure cars under well known trade names has educated the public, including a large group within the Army, to view a truck that is assembled from the products of different automobile manufacturers as an inferior article.

"Another and probably more serious stumbling block to this plan is the criticism of it which arises within the industry whenever the subject is raised. Nobody wants to lose the Army's business. It has never been suggested, however, that the Army should go into the manufacturing business to supply its own material for assembly jobs, and the standardization-by-assembling scheme has always provided for purchase of the units from the industry, on competitive bids.

"Whatever the developments of the next few years, there is no doubt in Army minds that the motor vehicle is and will continue to be a boon to their business. The problems they are working on at present look toward a system which will provide more efficiency and cheaper maintenance of their motor equipment in time of peace or war."

Industry Asked to Accept Wool Fabrics Standard

The recommended standard for Wool and Part-Wool Fabrics, TS-2202, and modifications to the recommendation, TS-2278, are now being circulated by the National Bureau of Standards for acceptance by manufacturers, distributors, and users.

The standard does not include fabrics used in blankets and knit underwear. It defines terms used to describe the fiber content of wool and part-wool fabrics, provides methods of test for determining the percentage by weight of the total fiber content represented by wool fibers, and illustrates the manner by which manufacturers and distributors may guarantee compliance with the commercial standard.

Copies may be obtained from the Division of Trade Standards, National Bureau of Standards, Washington, D. C.

Why *Radio* Needs Standards

Standards Affect Consumer Acceptance of Radio Sets, Production Operations, Purchase of Materials, Inspection, Servicing

ASA Radio Standardization Committee Offers Vehicle for General Standards Program

by

L. C. F. Horle[1]

Chairman, RMA Committee on Standardization of Component Parts

THE radio engineer daily faces problems for which standardization offers the best, and often the only, solution. All too often, however, he has appeared to feel that standardization is so full of mystery and standards once established, so to be revered, that one as intensely practical as himself can do little more than to look with awe and approbation on the standards already developed.

There may be several reasons for this viewpoint. It may be because radio communication up to the present time has been the work of experimentalists rather than of analysts, and that a fuller appreciation of the merits of standardization must await the further development of an analytical viewpoint. Or it may be, because this new, rapidly growing field of activity has drawn on young engineers rather than on more experienced, seasoned engineers, that perspective and the long-term viewpoint are lacking. The very fact that it is only within the last few years that any of our larger educational institutions have provided formal training for the profession of radio engineering may be one reason for some of the lack of appreciation of this formal codification of knowledge and experience which we call standardization.

Whatever the cause, the fact is that situations now ripe for standardization have failed to attract the attention of the radio engineer.

For instance, standardized nomenclature is vitally needed in so relatively youthful a field as radio engineering. The need for making published articles or discussions on radio subjects generally intelligible requires that the radio engineer develop such a rational terminology. Usage, in standardization of radio nomenclature as in all other types of standardization, must con-

[1]Consulting Radio Engineer.

tinue to be an important factor. But, in an art so young as radio, the opportunities for development of a rational nomenclature are so great that to permit usage, undirected, to dictate its terminology appears unjustifiably wasteful of human effort and intelligence.

Along with terminology and nomenclature there is, of course, the problem of developing systems of units and methods of measurement. Here, the radio engineer should draw on the work of those in other branches of science; otherwise, the units in which he expresses the characteristics of radio equipment may not be correlated with the fundamental laws of the physical sciences. In this case, serious barriers of nomenclature may prevent him from continuing, in the future, to draw on these other branches of science for available material which may be applied to his own branch of science. In this, of course, he is merely recognizing the standardization that has already been developed in other fields and upon which he can, if he will, build with complete consistency.

Allied to Acoustic Standards

It is in this field that radio standardization may be allied to the work already done under the procedure of the American Standards Association in many fields and, more particularly, on standard methods of noise measurement and specifications for a standard sound-level meter in their application to problems of testing loud speakers and in tests for the acoustic properties of broadcasting studios.

The radio engineer knows only too well the difficulties which will be met and the problems which must be solved in establishing standard measuring methods. In the interest of economy of effort he can well build on the work that has been done in other branches of the electrical and mechanical arts and sciences and extend that work into his own field.

It may be difficult, however, for the radio engineer to recognize what standardization in other fields has done for his own field of activity. He may not even know what organizations are working in his own field.

First, there are the groups and committees and conferences provided by the several organizations and societies which now encourage the frequent meetings of radio engineers to discuss their common problems. Of these, the Institute of Radio Engineers and the Radio Manufacturers Association are, of course, the outstandingly important organizations.

The Institute of Radio Engineers has many "standards committees" which hold frequent meetings, carry on continuous correspondence, and hold one annual and general meeting. Through this means, scientific development affecting the radio field is watched, discussed, and as far as possible, codified and published in the Institute's publications.

The Radio Manufacturers Association provides other standards committees which, through frequent meetings, continuous correspondence, and several annual meetings, observe and discuss the more practical aspects of scientific and industrial developments. These committees correlate and codify this information for the use of all concerned.

In addition, both of these major organizations are linked with other scientific and industrial groups and organizations, the work of which may be of interest to the radio engineer. Or these organizations may, conversely, because their fields touch upon or overlap his, be interested in his work on radio standards.

The American Standards Association provides the correlating agency for all these interests. When a number of different groups are concerned with a standard the American Standards Association offers the machinery for bringing together the different interests to present their viewpoints and to agree on a standard satisfactory to all.

The number of standards which logically belong only to one group or association is enormously greater than the number of American Standards, developed because of the interest of many groups in the problem. This is because a vast number of standards are required for highly specialized fields. These association standards should, however, be made consistent with such American Standards as apply to their particular field.

Many Groups on ASA Committee

The Sectional Committee on Radio-Electrical Coordination of the American Standards Association is an excellent example of the large number of groups which have a stake in a seemingly specialized standardization problem. Many of the problems before this committee could not possibly be solved without the cooperation of other representative groups, such as power companies, automobile manufacturers, communication companies, electrical machinery manufacturers, representatives of regulatory authorities and others, all of whom have a stake in whatever standards are written. Under the administration of the Radio Manufacturers Association, this committee has brought together representatives of all of these interests to agree on standards for the reduction of electrical interference.

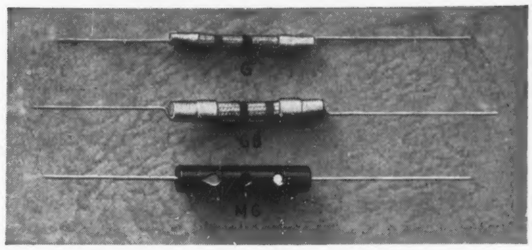
Standardization is not merely a technical matter; it nearly always spreads out into many company operations. A standard which influences

the design, material, or workmanship of a part of a radio set may easily become a significant factor in consumer acceptance of the set itself. This comes about through the effect of the standard on the cost of the set, the reliability of its operation, the ease and cost of servicing, and the like. At the very least, standards are bound to affect not only design, but also production operations, purchase of materials, inspection of parts, completed equipment, and the problem of servicing.

The radio industry is now entering the period where it can profitably consolidate its position through a well considered and carefully planned centralized program of standards. The importance of such a program in a type of activity closely related to radio was emphasized some time ago by Dr. Frank B. Jewett of the Bell Telephone System. He said that much of the progress of this System in the last two decades has been due to a process of alternating intensive research and development with periods of intensive standardization. The standardization process, he explained, was one of consolidating the gains made through research and developing the most useful results of research through selection and standardization.

The radio industry could well benefit from a similar process.

The machinery is at hand for a carefully planned program of this type. The general committee on Radio Standardization of the American



"Pigtail resistors" — members of the resistor family, which constitutes one of the most important components of a radio receiving set. Much thought has already been given to standardization of this type of resistor.

Standards Association has as members representatives of all of the groups having a substantial stake in the undertaking. It can be used for the development of needed standards whenever the radio industry and engineers recognize the importance of a definite program of standardization. The work already started is only the beginning of an effort that must continue and must grow for many years if it is to realize its full and ultimate usefulness, and if the radio engineer is to accept his full responsibility to his profession as well as to the general public.

Federal Specifications Revised, Now Available

Revisions to the following Federal Specifications, approved for all Government purchases of the material covered, have been made a part of the original specifications and copies are now available:

Bandages; Plaster of Paris GG-B-101, Amendment 1
Brick; Paving SS-B-671, Amendment 3
Brushes, Scrubbing; Hand, White-Tampico H-B-551, Amendment 1
Cans, Corrugated; Ash and Garbage RR-C-81, Amendment 1
Cord, Sash; Cotton, Braided T-C-571a, Amendment 1
Drums; Metal, Types 5A, 5C, and 5D (for Acids and Other Dangerous Articles) RR-D-701, Amendment 2
Gelatin C-G-191, Amendment 1
Paper; Bond, White and Colored UU-P-121a, Amendment 1
Paper; Chart, 100% Rag, Lithograph-Finish, White UU-P-171, Amendment 1
Paper; General Specifications UU-P-31, Amendment 1
Paper; Index UU-P-258, Amendment 1
Paper; Kraft UU-P-268, Amendment 1
Paper; Ledger UU-P-288, Amendment 1
Paper; Manifold UU-P-328a, Amendment 1
Paper; Mimeograph UU-P-388, Amendment 1
Paper; Printing, Book, Machine-Finish, UU-P-465, Amendment 1
Pressboard; Colored UU-P-701, Amendment 1
Scissors and Shears; Office GGG-S-101, Amendment 1
Tile; Acoustic SS-T-302, Amendment 1

Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.

New British Association Works on Retail Standards

According to a report from the London office of the Department of Commerce, the Board of Trade has approved the application for the incorporation under the Companies Act of the Retail Trading-Standards Association. The Association "will operate principally in the preparation of definitions of trading practices, etc., and will cooperate with the British Standards Institution in the establishment of standards of quality, performance and dimensions, and in all matters pertaining to marking for conformity thereto."

Truck Makers Support I.C.C. Safety Regulations

Belief that the adoption of proposed safety equipment regulations governing truck and bus operators by the Interstate Commerce Commission would result in bringing about greater uniformity in state regulations was expressed by a delegation representing the motor truck members of the Automobile Manufacturers Association at the hearing conducted by the Commission in Washington, D. C., recently.

David C. Fenner, New York, Vice President of Mack International Motor Truck Corporation, and spokesman for the group, voiced their support of the proposed regulations regarding the safety equipment to be required by the Commission on commercial motor vehicles. "We feel that substantially, they represent rules that can be intelligently applied to all types of equipment now in use in highway transportation," Mr. Fenner declared.

Commercial vehicle manufacturers, Mr. Fenner stated, have long recognized that the service rendered by motor trucks and buses must be coupled with a maximum degree of safety. He declared that this principle has been a dominating factor in the design and construction of vehicles.

"In our opinion, many existing statutes governing motor truck equipment have not kept pace with scientific improvements in vehicle and highway construction," he reported. "In sincere, but unscientific efforts to increase safety, many and varied rules have been written into the state laws. Some impractical regulations have been set forth upon occasion as safety measures but they have in reality operated to hamper the progress of motor transportation.

"Rules and regulations arising from these sources have, by and large, failed to increase safety," he contended. "They have, however, to a large extent burdened motor transportation with unnecessary costs and have limited its flexibility of operation and its economic advantages."

Mr. Fenner commented approvingly upon the declaration in the proposed regulations which sets forth the Commission's recognition that the art of motor vehicle construction and operation is one of constant change and improvement and that one of its guiding principles therefore will be to recognize the need for certain standards and yet have the way open for further technical advance.

In his appearance at the hearing, Mr. Fenner was accompanied by F. B. Lautzenhiser, Transportation Engineer, International Harvester Company; F. E. Evans, Chevrolet Motor Company; and Arthur C. Butler, Secretary of the Association's Motor Truck Committee.

A.S.T.M. Publication Includes All Its Textile Standards

All of the 42 A.S.T.M. standards covering various types of textile products have been issued in their latest approved form by the American Society for Testing Materials in a revised and amplified edition of the *Standards on Textile Materials*, sponsored by the A.S.T.M. Committee D-13.

In addition to all A.S.T.M. standards on textiles, there are included a proposed potassium dichromate oxidation method for the determination of total iron in asbestos textiles, a psychrometric table for relative humidity which combines both accuracy and convenience to an exceptional degree, a section comprising many excellent photomicrographs of common textile fibers and a convenient yarn number conversion table. Also included are proposed methods covering the testing of wool felt and correction of breaking strength to standard regain.

During the past year, nine outstanding technical papers were presented at meetings of the committee and extensive abstracts of these papers are given in the new edition of the *Standards*.

The 1936 edition contains for the first time new methods of testing applying to pile floor covering; fineness of wool; corded cotton gray goods; yarn slippage in silk, rayon and silk-rayon woven broad goods; and fastness to laundering or domestic washing of dyed or printed cotton fabrics and printed silk or rayon fabrics.

During 1935-1936 changes have been made in standards covering woolen and worsted yarns, definitions and terms, silk and cotton tapes, cotton yarns, cotton sewing threads, asbestos tape, cotton tape, light and medium cotton fabrics, hose and belt ducks, methods of testing woven fabrics, and in the test for small amounts of copper and manganese in textiles.

In addition to the above materials a large number of other textile products are covered, such as, testing machines, tire fabrics, tire cord, sewing threads, and sugar bags.

Copies of this 275-page publication may be obtained from the American Society for Testing Materials, 260 S. Broad Street, Philadelphia, at $2.00, heavy paper binding.

Rug Labels Show Quality; Meet Consumer Demand

Says Maker

AS an answer to what the company considers "a remarkable change in the attitude of consumers who spend the family income" four grades of Wilton rugs manufactured by the M. J. Whittall Associates, Ltd., of Worcester, Mass., now carry labels outlining detailed specifications for consumer information.

The labeling policy, established with the help of Roger Wolcott, Inc., advertising agency, followed a study in retail stores in prominent cities of what consumers want to know about rugs.

"The labels of the Wilton rugs as adopted by the M. J. Whittall Associates, Ltd., are standards not only for the trade, but also for consumers who want facts on labels," says the announcement of the new policy by Roger Wolcott, Inc. "These labels enable women to ask intelligent questions and to demand equally intelligent answers from sales people when they are attempting to compare one rug with another. It marks the end of 'blind buying' as it applies to rugs."

The four grades of rugs carrying the Whittall labels are known as Anglo Persian Wilton, Sheraton Wilton, Palmer Wilton, and Baystate Wilton.

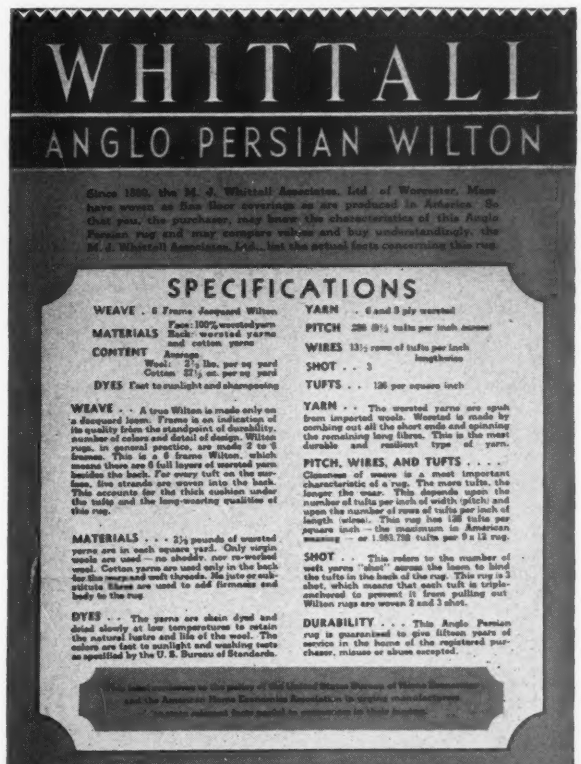
The labels give definite information on details which determine a rug's quality—weave, materials, content, dyes, yarn, pitch, wires, shot, and tufts of each type of rug—with explanatory paragraphs interpreting the information in terms indicating its value to the user.

Best Quality Guaranteed

The highest quality Whittall Wilton, the Anglo Persian Rug, is guaranteed to give fifteen years of service in the home of the registered purchaser, misuse, or abuse excepted. Thus, the label Anglo Persian gives consumers the relevant facts about performance as well as construction.

In explaining their policy of giving definite specification information for the benefit of buyers, the Whittall Company says:

"A remarkable change has taken place in the attitude of those consumers who spend the family income. Consumers now insist on facts with a more definite knowledge of values. One of the most important means to this end is the 'informative label' which states essential facts relating to the product. While encouraging progress has already been made, it is but a surface indication of what is to follow. This movement will go far.



It is predicted that the 'informative label' already adopted by some manufacturers must soon be a general practice.

"The manufacturer who now depends upon his reputation alone, or upon general advertising claims does not recognize this great change in the attitude of buyers. The women of this country are demanding facts when they spend money. Price is no longer accepted as a proof of value. A statement of quality must justify the price. People are obliged to spend money, but they must be sure of value received for the money they spend. No manufacturer can avoid meeting this issue. It originated with the women who spend money upon which the existence of his business depends.

"Among the leaders of this movement are the Bureau of Home Economics of the U. S. Department of Agriculture, the American Home Economics Association, the National League of Women Voters, the American Association of University Women, Parent-Teachers Associations, the American Federation of Women's Clubs, and other organizations that reach millions of women."

Thompson Represents Power Group As Member ASA Standards Council

P. W. Thompson, Detroit Edison Company, has been appointed by the Electric Light and Power Group as its representative on the Standards Council, the general committee of the American Standards Association in charge of approval of all standards by the ASA.

Mr. Thompson, who will represent the Group on the Standards Council for the term 1937-1939, succeeds I. E. Moultrop, Edison Electric Illuminating Company of Boston.

The Electric Light and Power Group, Member-Body of the American Standards Association, is made up of the Association of Edison Illuminating Companies and the Edison Electric Institute.

W. C. Wagner, Philadelphia Electric Company, and R. H. Tapscott, New York Edison Company, continue as the other two representatives of the Group on the Standards Council.

Standard Viscometers Will Test German Mineral Oil Viscosity

The demands made by industry in Germany for accurate standardization of technical viscometers has led the Reichsanstalt to construct an absolute viscometer for the determination of the viscosities at different temperatures of a series of mineral oils which change little with time. These can be used for the standardization of industrial viscometers.

The liquid is forced by air pressure in succession through two capillary tubes of the same diameter, one short and the other long, which connect three metal cylinders of 4—5 cm diameter, from which vertical glass tubes ascend to serve as manometers. The pressures are read by cathetometer and their differences for the long and short tubes enable the end effects to be eliminated.

The apparatus is immersed in a bath at constant temperature with the capillary tubes horizontal. It has been found that carefully selected tubes drawn in the ordinary way have smoother internal surfaces and are more suitable than tubes formed in the plastic state about a mandril.

To facilitate change of capillary tubes their connections to the metal tubes are made by pipe unions which screw against perforated steel spheres cemented to the capillaries close to their ends. The capillaries are calibrated by mercury threads. An accuracy of 0.2 per cent for the viscosity is attained.

Plastics Industry Asks For Standard Test Methods

"A subject which has been suggested to the National Bureau of Standards by several members of the industry as meriting immediate attention is the matter of test methods for plastics.

"This is a branch of scientific endeavor in which the Bureau has made many contributions in other fields. There is no doubt that despite the notable work of Committee D-9 of the American Society for Testing Materials in establishing standard procedures for testing insulating materials, there exists considerable non-uniformity and confusion in many of the tests not considered by this group.

"At present there is considerable difficulty in obtaining reliable comparisons based on results in different laboratories. Furthermore, there is a real need for more data on the properties of plastics.

"If the plastics industry were organized into an association similar to those existing in the rubber, textile, paper, and leather industries, it would be an easy matter to proceed with a standardization program in the matter of tests. In fact, this has been one of the first problems which these trade associations have tried to solve.

"The Bureau hopes to obtain the active cooperation of the industry in its work, to the end that real progress may be made toward providing better and more uniform data on the properties of plastics."—*Technical News Bulletin, December.*

A.S.T.M. Textile Committees Expand Standards Program

PROTECTION of metal against corrosion, for many years one of the biggest technical and economic problems of industry, may be solved through the series of tests on resistance of metals to atmospheric corrosion now being carried out by the American Society for Testing Materials. This series of tests, which covers bare (uncoated) iron and steel sheets, and metallic coatings on various shapes, has just been broadened to include tests on wire and wire products.

Data obtained from these tests are expected to form the basis for standard specifications for coating wire to resist atmospheric corrosion.

Results of atmospheric corrosion studies already carried out by the A.S.T.M. have been the basis of the work of ASA Sectional Committee on Zinc Coating of Iron and Steel (G8), under the administrative leadership of the American Society for Testing Materials. This committee has already completed specifications for several types of zinc-coated materials which have been approved by the American Standards Association.[1] Additional information obtained from the new series of tests will give the committee material upon which it can base revisions of existing standards and preparation of the new standards for zinc coatings for wire and wire products.

Almost 11,000 (10,886 to be exact) test specimens are involved in the country-wide series of atmospheric corrosion tests of wire and wire products which the A.S.T.M. is now starting. Specimens of plain unfabricated wire, barbed wire, wire strand, farm fence, and chain-link fence have been assembled at several of the 11 test sites and the remainder will be completed within the next few weeks. Involved in the tests are about six miles of plain wire, over a mile of barbed wire, about one-half mile of strand, about two miles of farm fence, and one-third mile of chain-link fence.

This vast research program has two major objectives: (1) to obtain essential engineering information concerning the materials involved, and (2) to assist in establishing national standard specifications for fencing, barbed wire, and the other products which will afford consumers an adequate guide in purchasing the materials.

The American Society for Testing Materials has been supervising atmospheric corrosion tests for more than 20 years. Under the direct super-

[1] Zinc-coated (galvanized) sheets (G8b1-1931; A.S.T.M. A93-27); Zinc coatings on structural steel shapes, plates and bars and their products (G8.1-1933; A.S.T.M. A123-33); Zinc-coated (Galvanized iron or steel telephone and telegraph line wire (G8.3-1935; A.S.T.M. A111-33); Zinc-coated (galvanized) iron or steel tie wires (G8.4-1935; A.S.T.M. A112-33); Zinc-coated iron or steel chain-link fence fabric galvanized after weaving (G8.5-1935; A.S.T.M. A117-33); Zinc-coated (galvanized) iron or steel wire strand (cable) (G8.6-1935; A.S.T.M. A122-33); Black and hot-dipped zinc-coated (galvanized) welded and seamless steel pipe for ordinary uses (G8.7-1935; A.S.T.M. A120-34T).

Literally miles of different types of wire fencing have been erected by the American Society for Testing Materials in an attempt to find out how it resists atmospheric corrosion. The fence being tested at Purdue University, Lafayette, Ind., is shown here.

J. C. Allen & Son

vision of A.S.T.M. Committee A-5 on corrosion of iron and steel, studies were commenced in 1916 on uncoated iron and steel sheets and metallic coatings on various shapes.

These tests so clearly demonstrated the value of long-time corrosion tests, conducted upon a co-operative basis by producer and consumer under the auspices of a neutral, impartial body, that Committee A-5 planned a similar study of metallic coatings—principally of zinc but including also cadmium, aluminum, lead, and copper—on (1) iron and steel sheets; (2) shapes, hardware, and tubular goods; and (3) wire and wire products exposed to different types of atmosphere. The first two parts of the investigation were started in 1925 and 1929, respectively. The third part is just beginning.

"Economic considerations in general dictate the undertaking of research investigation," says the American Society for Testing Materials in announcing the test program on wire products. "To make the proper decisions in selection of materials and types of coatings that will best meet a given set of conditions, the facts must first of all be established.

"It is believed that the present investigations will give many of the desired facts. The facts must then be properly interpreted, both by individual engineers for their own specific problems and by the Society from a somewhat more general viewpoint. Then with the facts known and properly interpreted, it will be possible to record the knowledge in the usable form of standard specifications thus facilitating the economic procurement of metallic-coated products of various types to meet various conditions.

"Such specifications, as should be true of all such standards, are not to be thought of as fixed and unchangeable, but rather as temporary landings at which to rest, review progress, and gather new energy for the further climb toward better things. The development of adequate specifications for metallic coatings is one of the important objectives of the present research."

How Government Standards Apply to Canned Foods

How and why Government grades and standards for canned fruits and vegetables are used, and to what they apply, is described in "Standard Facts, Answers to Consumers' Questions" in *Consumers' Guide*, July 27.

"Millions of dozens of cans of canned foods are now sold annually on the basis of Government grades," says the article in explaining why it seemed important to publish this definite information about how the Government grading plan works. "Huge loans are frequently supported by official certificates indicating the quality of canned foods covered by warehouse receipts. Millions upon millions of labels on canned fruits and vegetables indicate the quality of canned products in the terms of Department of Agriculture grades for the assistance of the consumer.

"News of the progress in A, B, C grade labeling on the cans consumers buy has frequently appeared on the pages of the *Consumers' Guide*. Readers who follow the *Guide* have shown their interest in this news and in the significance in general of grades and standards on consumer goods. This interest has expressed itself in questions on the more technical aspects of the situation: Just how this Government grading service came into being, how it operates, what is its procedure, and how it is used.

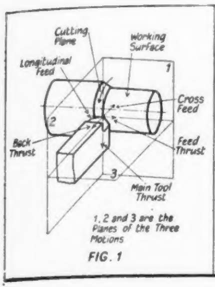
"Questions reflecting this expanding interest are published here, with their answers from the Bureau of Agricultural Economics, whose experts formulate standards for canned goods and perform the grading."

British Revise Standards For Electrical Transformers

Two standard specifications for electrical transformers have just been issued by the British Standards Institution.

The first, Electrical Performance of Transformers for Power and Lighting Purposes, BSS No. 171-1936, is a revised edition of a former standard. The changes bring the provisions up-to-date. For instance, the temperature rises take account of the improved methods of cooling now available and particular attention has been paid to the fact that the specifications will be used throughout the British Empire. The specifications, with their terminal markings, vector diagrams, details of high voltage tests, etc., might almost be regarded as a text-book on the subject, says *Electrical Industries*, London.

The second specification is a revised edition of publication No. 81, on instrument transformers. The changes included in the new edition apply to the high voltage test which is now based on system conditions, and an induced voltage test. The requirements as to accuracy have been made more severe and new requirements with regard to overloads have been introduced. In both cases a maximum temperature of 40 C is assumed, the average temperature being 35 C.



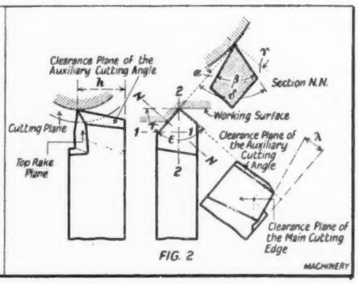


Fig. 1
Diagram showing the directions of feed and rotation of work, and the forces involved

Fig. 2
Definition of various planes and angles of cutting tools

Germans Define Right-Hand Tool In New Cutting-Tool Standard

American Industry Is Now Considering Two Proposals for Similar Standard

A SERIES of thirteen new German standard sheets on single point cutting tools has been published by the national standardizing body in Germany (Deutscher Normenausschuss).

In the United States, two committees have been active on this subject during recent years. One is Technical Committee 19 on Single Point Cutting Tools, a subcommittee of ASA Sectional Committee B5 on Small Tools and Machine Tool Elements. The other is the Special Research Committee on Cutting of Metals of the American Society of Mechanical Engineers. In the spring of this year, a list of definitions proposed by each of these committees was sent out by the A.S.M.E. Standardization Committee with a questionnaire.

It may be interesting to our readers to see the general way in which this matter has been dealt with on 12 of the German sheets, as reproduced from an article by Professor F. Meyerberg in *Machinery* (European edition), August 6, 1936.

The diagrams correspond to the following German standards (DIN sheets):

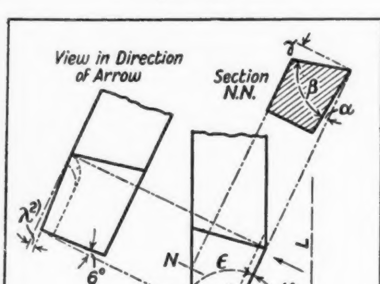
Figure	*DIN Sheet*
3	4951
4	4952
5	4953
6	4954
7	4955
8	4956
9	4957
10	4958
11	4959
12	4960
13	4962
14	4963

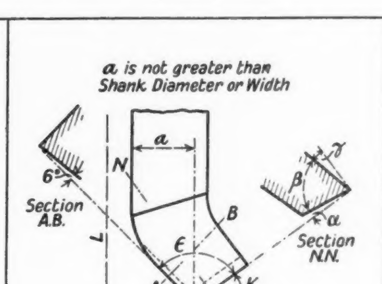
These DIN sheets may be borrowed from the American Standards Association. (NOTE: DIN

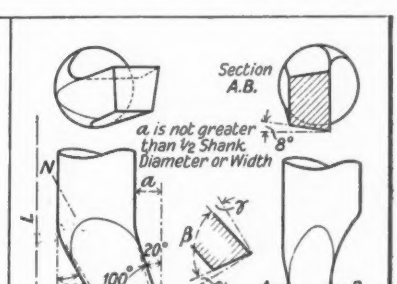
Fig. 3
Straight right-hand roughing tool

Fig. 4
Bent right-hand roughing tool

Fig. 5
Internal roughing tool for boring straight-through holes







Sheet 4961, which is also available from the ASA office is not referred to in the article.)

The following is an abstract from the *Machinery* article, August 6:

"It was first necessary to define the factors involved as simply and as significantly as possible, and to eliminate all possibility of ambiguity. The terms adopted are shown in Fig. 1 and 2, which give the three directions of motion; the three components of thrust; and the different planes and angles of the cutting tools.

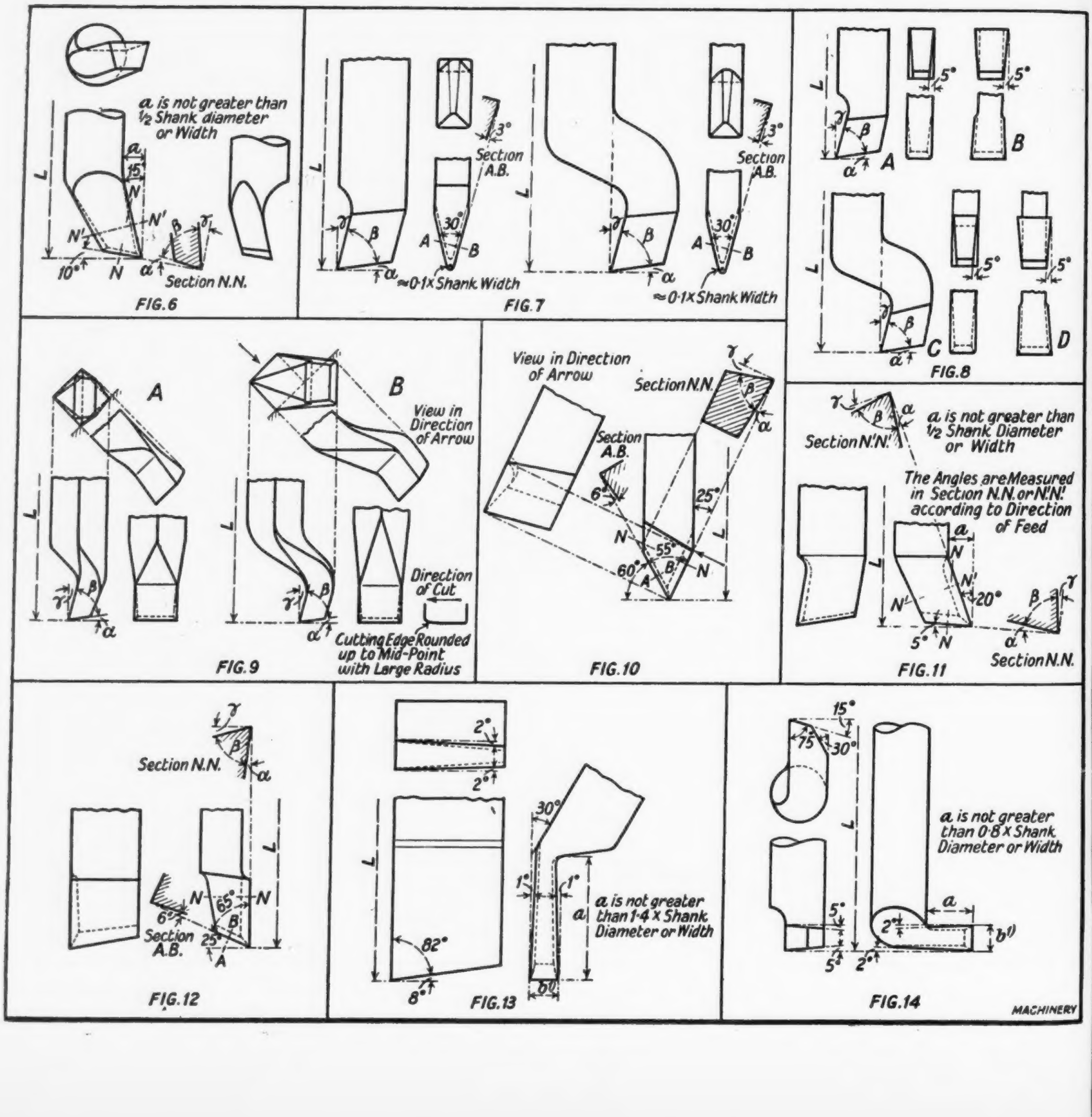
"The next step was to standardize the various types of cutting tools, as shown in the illustrations, Fig. 3 to 14.

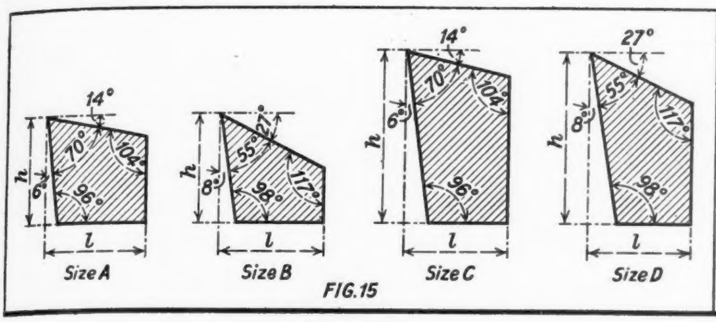
"Left-hand tools are the equivalent of mirror images of the right-hand tools shown.

"The foregoing were necessary preliminaries to the actual standardization which involved determining the angles suitable for machining different materials, and was the most difficult part of the work.

"The sections of material for the tips of tipped

Fig. 6. *Internal side tool for boring blind holes;* Fig. 7. *Pointed smoothing tools, straight and bent types;* Fig. 8. *Broad slotting tools. A—Straight; B—Straight with wider cutting edge; C—Bent; D—Bent with wider cutting edge;* Fig. 9. *Twisted smoothing tools. Straight and bent types are shown at A and B, respectively;* Fig. 10. *Straight side tool;* Fig. 11. *Bent side tool;* Fig. 12. *Right-hand knife tool;* Fig. 13. *Bent parting tool, left-hand;* Fig. 14. *Undercutting tool.*





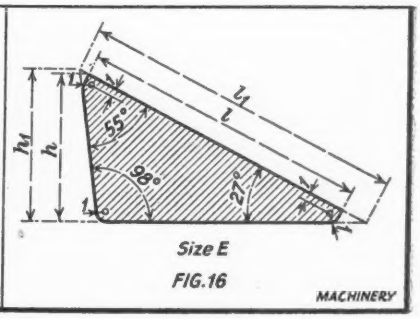


Fig. 15
Sections of rolled bar for quadrilateral tool tips

Fig. 16
Sections rolled bar for triangular tool tips

tools have been standardized. There are two different types, quadrilateral, as in Fig. 15, and triangular, as in Fig. 16, the dimensions of which are given in Tables 3 and 4, respectively.

"The advantages gained by the standardization of cutting tools are obvious. In particular, by using gages and jigs corresponding to the standardized dimensions, provision of the most suitable tool for any given purpose is considerably facilitated."

Industry Cooperates In ASA Projects

"Frequently in the last few years somebody has been heard saying that business cannot work in harmony without some government interference. . . . Those who make the charge are ignorant of what has been going on for many years in fields where business has common interests, such as standardization of materials. The official organ of the American Standards Association, *Industrial Standardization*, reveals the varied activities of committees appointed by business men to set up standards.

"The latest number of this periodical carries an article on the classification of coal; the committee responsible for this has a membership representing twenty different technical and commercial societies. The same issue of *Industrial Standardization* carries references to building codes, standards for crushed stone, a shrinkage test for woven cotton cloth, automobile parts standards, terminal markings for electrical machinery, petroleum tests, safety in buildings, life-saving technique, the markings for valves and fittings, standards for surgical methods, motor car headlights, rubber belting, crankcase oil, fruit juices, molasses, cheese, cotton duck, iron pipe, and plate glass."—*New York Sun, Dec. 7, 1936.*

Albert Perard Appointed Director Of International Weights Bureau

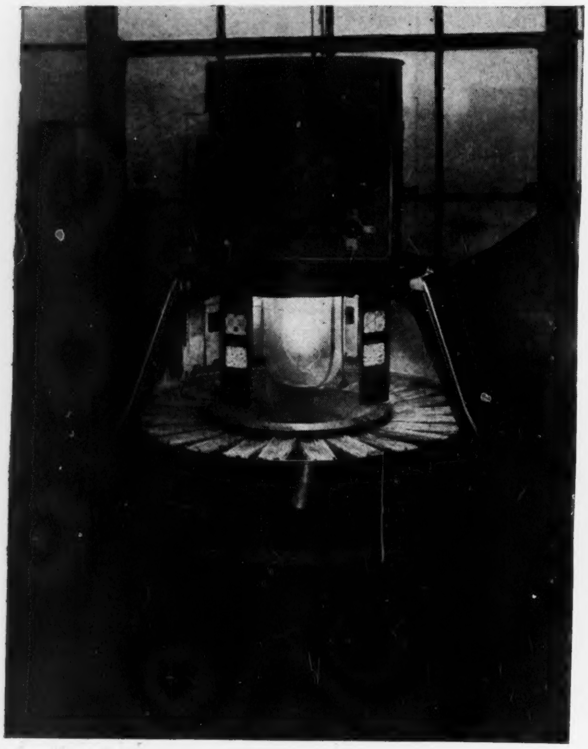
The International Committee on Weights and Measures announces the appointment of Albert Perard as Director of the International Bureau of Weights and Measures, effective October 22. M. Perard succeeds Dr. Charles-Edouard Guillaume, who retired after serving in the Bureau for 53 years and as its Director since May, 1915. Dr. Guillaume has been named Honorary Director of the Bureau.

M. Perard has been attached to the International Bureau since 1905, and is widely known for his work on methods and instruments for precise measurement, particularly the measurement of lengths by means of wave-lengths of light. More recently he has also had charge of the electrical measurements which constitute a new field of work for the International Bureau, and has carried out precise comparisons of the electrical units as maintained in different countries. He was made Assistant Director of the Bureau in 1931.

Standardization Is Basis For Low-Cost Modern Homes

Standardization of floor plans, with different elevations, standardization of duct work, and coordination of various mechanical phases is the secret of low-cost completely modern homes, plans for which were recently completed by the Kelvinator Corporation of Detroit, according to a news item in the *New York Herald-Tribune*, October 18.

"The Kelvinator Corporation has developed the home but is not going into the business of building or selling houses," says the article. "Instead, it has prepared and is making available designs and specifications for the guidance of architects and contractors."



The Fade-Ometer — which shows how soon a piece of material will fade when exposed to a strong light.

Cause of Consumers' Complaints on Textiles Uncertain Under Old Non-Standard Test Methods

New Commercial Standard Makes Possible Comparison of Test Results

Standard Tests Compare Quality of Dress Fabrics[1]

by

Herbert A. Ehrman

Division of Trade Standards, National Bureau of Standards

WITH the growth of textile testing and research, there has naturally developed a lack of agreement on test procedures, which prevented a comparison of test results. It became evident that there was need for a standard to establish methods of testing and reporting dress fabrics on a nationally recognized basis in order that laboratories may proceed by identical methods in making tests, and in order that reports to the individual dress manufacturers, retailers and other clients may have an identical significance.

At the request of the National Retail Dry Goods Association, and with the hearty cooperation of commercial textile testing laboratories, Woven Dress Fabrics—Testing and Reporting, Commercial Standard CS59-36, has been developed, approved, and accepted by industry with the cooperation of the National Bureau of Standards. This standard became effective April 15, 1936, as a basis for testing and reporting woven dress fabrics and is expected to reduce the number of consumer complaints and bring about a solution of

[1]Publication approved by the Director of the National Bureau of Standards of the U. S. Department of Commerce.

the differences of opinion between fabric manufacturers, converters, finishers, dress manufacturers, and distributors over the causes of consumer complaints.

The standard provides in detail standard methods of testing and reporting results of tests on woven dress fabrics as to breaking strength; color fastness to crocking (rubbing); cleaning (dry and wet), drypressing, laundering and light; shrinkage; and resistance to yarn slippage. The methods apply to fabrics comprised of cotton, linen, wool, silk, rayon and other synthetic fibers, and mixtures thereof. These methods as accepted and promulgated include a number of methods developed and published by the American Society for Testing Materials.

Test Reports Definite

In reporting results on color fastness to light, laundering and crocking, the standard requires comparison with standard dyeings of the American Association of Textile Chemists and Colorists. By so doing, indefinite terms such as "objectionable" and "satisfactory" are avoided. Test reports are, therefore, much more definite and the standard more specific than it otherwise would have been.

The standard constitutes the first step towards the rating of dress fabrics on the basis of serviceability. It illustrates the manner by which a laboratory may certify to its clients compliance with the test methods. Probably the time is not far distant when some fabric mills may certify through the dress manufacturer to the retailer that the fabric has certain values as revealed by the standard tests, thereby permitting the retailer to accept a greater degree of responsibility in his dealings with the ultimate consumer.

The whole approach to this problem has been from the consumer's point of view without in any way limiting the manufacturer as to fiber content or methods of processing or finishing, but merely to obtain results of their fabrics on a performance basis.

"The most comprehensive single piece of standardization ever attempted by or for the textile industry" is the opinion of one interested commentator on Woven Dress Fabrics—Testing and Reporting, Commercial Standard CS59-36.

Copies of the standard are now available from the Superintendent of Documents, Government Printing Office, Washington, D. C., at five cents each (stamps not accepted).

Will this fabric tear or pull apart? Laboratory tests by machines like this give the answer. Insert shows close-up of a piece of test material held in the jaws of the machine as the strain slowly tears it apart.

What about laundering? And the Launder-Ometer answers the question. If the color of the samples stays fresh under this treatment, your dress goods will launder without fading.